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UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

TECHNICAL LETTER NASA-11

GEOLOGIC MAP OF THE PISGAH AND SUNSHINE CONE LAVA FIELDS*

by

William S. Wise**

These data are preliminary and should not be quoted without permission.

*Work performed under NASA Contract No. R-146

**University of California, Santa Barbara

Prepared by the Geological Survey
for the National Aeronautics and
Space Administration (NASA)

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Technical Letter
NASA - 11
March 10, 1966

Dr. Peter C. Badgley
Program Chief - Natural Resources
Space Application Programs Office
Office of Space Science and Applications
Code SAR NASA Headquarters
4th & Maryland Avenue, S. W.
Washington, D. C. 20546

Dear Peter:

Transmitted herewith are 5 copies of:

TECHNICAL LETTER NASA-11

GEOLOGIC MAP OF THE PISGAH AND SUNSHINE CONE LAVA FIELDS*

by

WILLIAM S. WISE**

Sincerely yours,

R. M. Moxham
Research Geophysicist
Branch of Theoretical Geophysics

*Work performed under NASA Contract No. R-146
**University of California, Santa Barbara

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INTRODUCTION

The accompanying geologic map shows the distribution of the Pisgah and Sunshine Cone lavas (and their fragmental equivalents) in the vicinity of Pisgah Crater, San Bernardino County, California.

The geologic setting, descriptions of the various geologic units in the area, and smaller scale geologic maps have been previously transmitted in reports by Gawarecki (1964) and Dibblee (1965). Preliminary results of some infrared surveys has been given by Fischer, et al., (1965). A detailed topographic study has been made by Altenhofen, et al., (1965).

The present mapping presents the geology at a scale of 1:24,000 on four adjoining sheets (see index map); sheet 5 is a 1:12,000 scale detailed map of the Pisgah Crater area.

Subsequent editions of these maps will present additional details on the unconsolidated deposits adjoining the flows.

SUMMARY OF THE GEOLOGIC HISTORY OF THE PISGAH AND SUNSHINE CONE LAVA FIELDS

Pisgah lava field

The Pisgah lava field was formed in three distinct eruptive phases each separated by a fairly long period of time. Separation of flows into each phase is based solely on the texture of the phenocryst minerals.

First Eruptive Phase.

Activity began with the building of a cinder cone (low hills north of what is now the main cone), and lava issued from vents near the cone. Lava flowed only 1 1/2 miles north but extended five miles southeast to Lavic Lake, where it covered nearly five square miles of the lake bed area. Two long flows went down the gentle drainage to the west. Wind blown sand and alluvium have partly covered these flows. In most localities the top of the lava is only a few feet above the surrounding alluvium. The cinder cone has been almost destroyed by subsequent erosion.

These lavas are microporphyritic alkali-olivine basalt. Microphenocrysts of olivine (smaller than 2 mm) are scattered and rare. Groundmass minerals are olivine, plagioclase, titanaugite, magnetite, and ilmenite.

Second Eruptive Phase.

After a long period of quiescence lava again rose through apparently two separate conduits. One carried most of the volatiles, and a cinder cone was built where it broke through to the surface (about 1000 feet south of the site of the older cone). Lava rising in the other conduit encountered a thick lava flow through which it failed, at first, to penetrate. The older basalt was domed upward 150' by the new magma, which possibly formed a small laccolith. The older lava cover finally broke and lava welled out of several vents around the dome. More upwelling buckled earlier lava (but not that which had been erupted during this phase), forming a "tongue" between the dome and the cinder cone.

These lavas were as voluminous as those in the first phase -- flows extended 11 miles to the west, 2 1/2 miles north, and 4 miles to the south. The lava surface is largely aa, though pahoehoe surfaces are on most of the long westward flow. Wind blown sand and alluvium covered the lavas locally.

The basalt is porphyritic with olivine (2-3 mm) and plagioclase (2-5 mm) phenocrysts. Groundmass minerals are the same as in the earlier flows.

Final Eruptive Phase.

Again magma rose in two columns -- one forming the present cinder cone and the other erupting only lava. The lava vents were over one mile south of the cinder cone, and there was no accompanying cinder activity. Lava also issued from a vent on the side of the cinder cone and from a small vent on the "tongue", formed during the second phase.

These flows extended only about half as far as the earlier ones. Interesting features of these flows include the repeated piling against an alluvial fan to the south. The flow surface is pahoehoe over its entirety, though pressure ridges and tumuli are common.

Plagioclase phenocrysts larger than 10 mm and clots of olivine crystals about 5-6 mm across serve to distinguish these flows from the earlier ones. However, the overall groundmass mineralogy is similar.

Intensive discharge in the wash to the south of the lava flow has brought enough alluvium to cover a portion of the flow. Wind blown sand easily accumulates on the pahoehoe surface, giving the illusion that the aa flows (second eruptive phase) are the youngest.

Sunshine Cone lava field

The Sunshine Cone lava field consists of two flows. The older, here termed the Lavic flow, probably antedates the first eruptive phase at Pisgah, based upon the relative state of erosion. The faulted remnant of an eroded cinder cone marks the area from which the Lavic flow originated.

The lava consists of porphyritic alkali-olivine basalt. Single phenocrysts, as well as scattered glomerporphyritic clots of plagioclase and olivine occur in a groundmass of plagioclase, titanaugite, olivine, magnetite, ilmenite, and anorthoclase. Rare, but consistently present phenocrysts of titanaugite (dark brown prisms) set these lavas apart from all others in the Pisgah area. Original surface irregularities have been almost completely removed by weathering and erosion.

The Sunshine Cone flows issued from Sunshine Cone probably sometime between the first and second Pisgah eruptive phases. The Sunshine Cone flows are alkali-olivine basalt. Scattered olivine phenocrysts (about 3-5 mm) occur in a groundmass of plagioclase, titanaugite, olivine, magnetite, ilmenite, and anorthoclase. Plagioclase phenocrysts are very rare to absent in the area of the test strip, although they are abundant in a later flow on the southern end of the lava field. (This later flow is beyond the area mapped but can generally be recognized by the hummocky surface.

Original surface irregularities of the Sunshine Cone flow are only partially removed by weathering and erosion.

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Altenhofen, R. E., Oman, J. K., and Sousa, T. M., 1965, Topographic studies of Pisgah Crater, California: U. S. Geol. Survey, Tech. Letter NASA - 7.

Dibblee, T. W., Jr., 1965, Preliminary geologic map - Pisgah Crater and vicinity, California: U. S. Geol. Survey, Tech. Letter NASA - 4.

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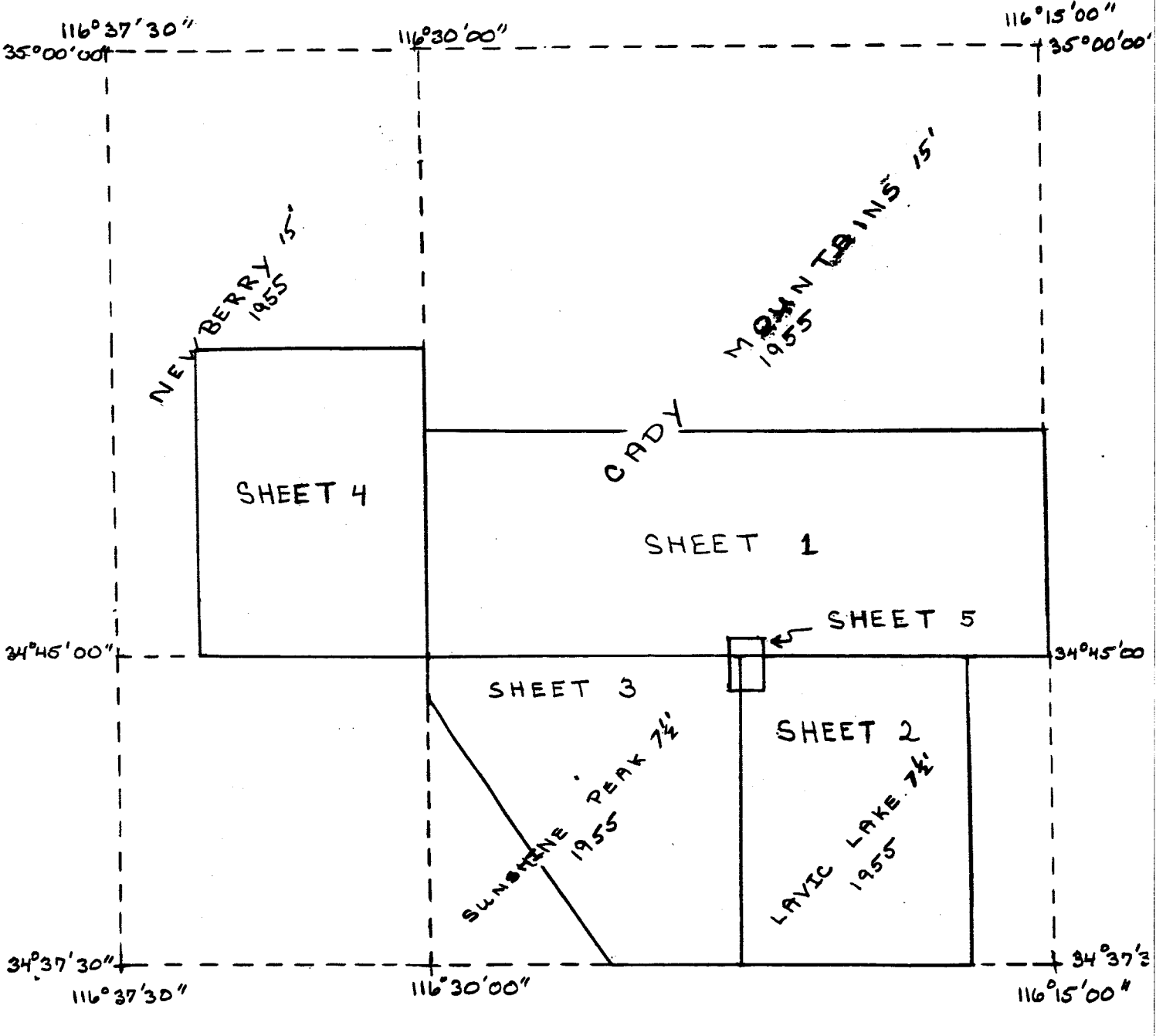
Gawarecki, S. J., 1964, Geologic reconnaissance report of the Pisgah Crater, California, area: U. S. Geol. Survey, Tech. Letter NASA - 2.

INDEX MAP



Names shown on diagonal are U.S.G.S. topographic base maps.

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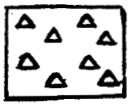
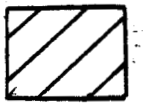
EXPLANATION FOR GEOLOGIC MAPS (SHEETS 1-5) OF THE PISGAH AND SUNSHINE CONE LAVAS, SAN BERNARDINO COUNTY, CALIFORNIA

Pisgah Lavas

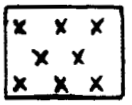


CINDERS
(SHEET 5)

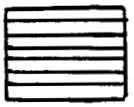


FLOWS

Porphyritic olivine basalt of final eruptive phase



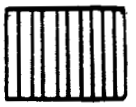
CINDERS
(SHEETS 5)



FLOWS

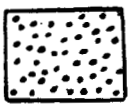
Porphyritic olivine basalt of second eruptive phase

CINDERS
(SHEET 5)

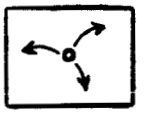


FLOWS

Microporphyritic olivine basalt of the first eruptive phase

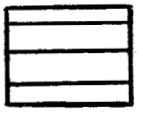


CINDER CONE
(Sheets 1, 2 and 3 only)



Lava vent, with flow directions of last flow on surface

Sunshine Cone Lavas



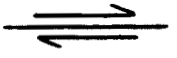
Sunshine Cone Flows

Alkali-olivine basalt

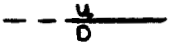
Lavic Flows

Porphyritic alkali-olivine basalt

Note: Geologic symbols are dashed where bedrock is covered by alluvium

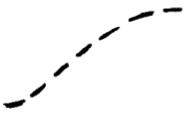


Lateral



Normal

Faults (only faults with visible scarps are shown)



Lava tubes (indicated by collapsed roof)

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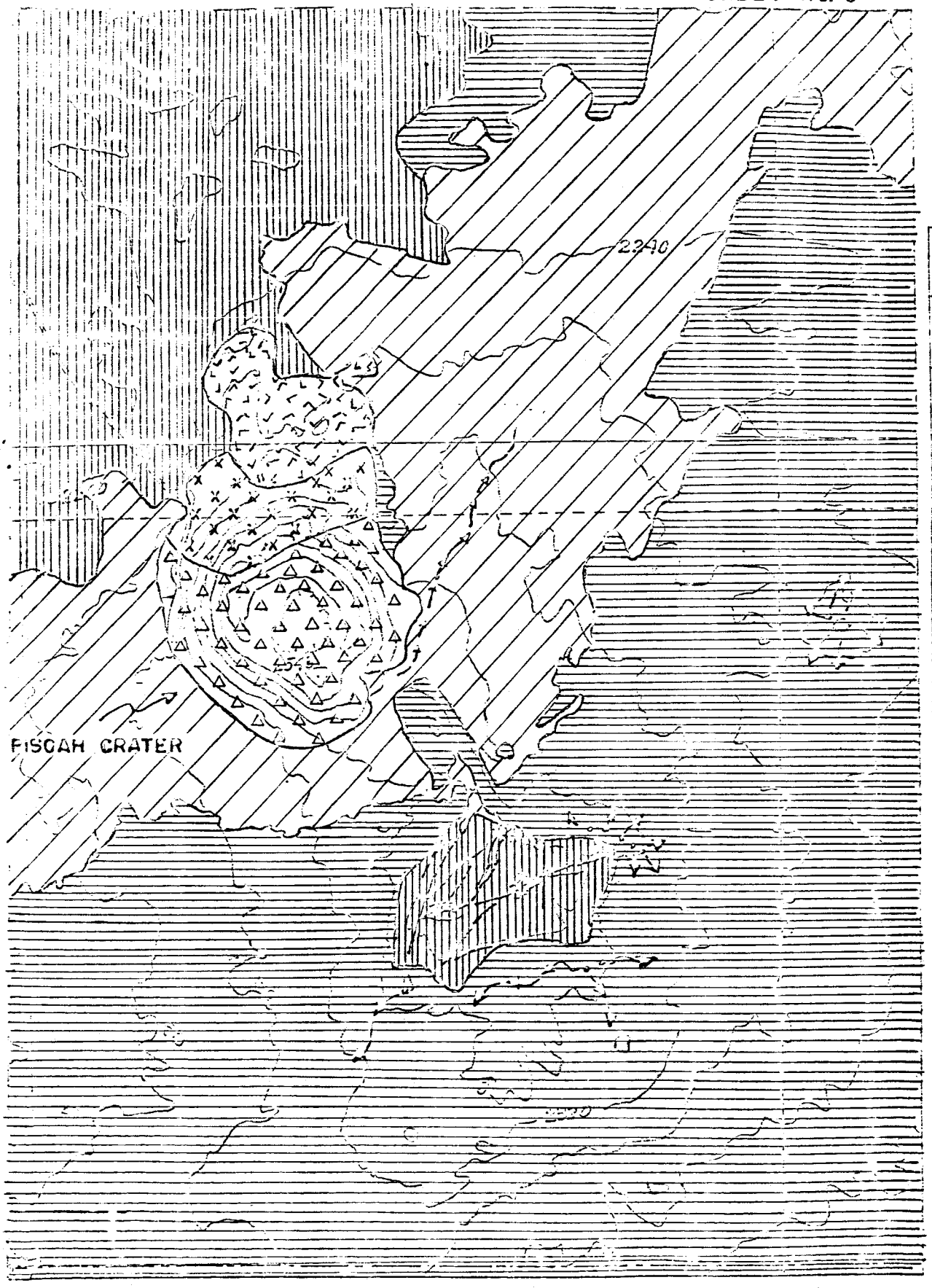
SHEET NO. 5



GEOLOGIC MAP OF THE PISGAH AND SUNSHINE CONE LAVAS
SAN BERNARDINO COUNTY, CALIFORNIA